Monthly report No. 3
Fabrication of long wavelength array
by in-situ molecular beam epitaxy
(contract No. DAAB07-91-C-K762)

1.0 Summary of progress

During this reporting period, we have performed the epitaxial growth of fluoride buffer on Si substrate. A single crystal BaF_2 epilayer with IR transparency in the 2- 12μm ranges and smooth surface is found suitable as a lattice matching buffer layer. We have also proceeded to optimize the growth of InAsSb films. Results obtained so far are presented and briefly discussed in this report.

2.0 Optimization of fluoride buffer epilayer

We have grown several BaF_2 epilayers on Si substrate to test out their crystal quality. X-ray diffraction and optical microscopy measured on BaF_2 layers are shown in Figs. 1 and 2, respectively. A single BaF_2 peak, shown in Fig. 1, reveals a single crystallinity of BaF_2 on Si. The mirror-like surface, shown in Fig. 2, reveals no evidence of cracked edges due to lattice mismatch. The IR transmission of the BaF_2 epilayers is shown in Fig. 3, showing high IR transparency in the 2 - 12μm band. These results reveal high buffering quality of the BaF_2 layer.

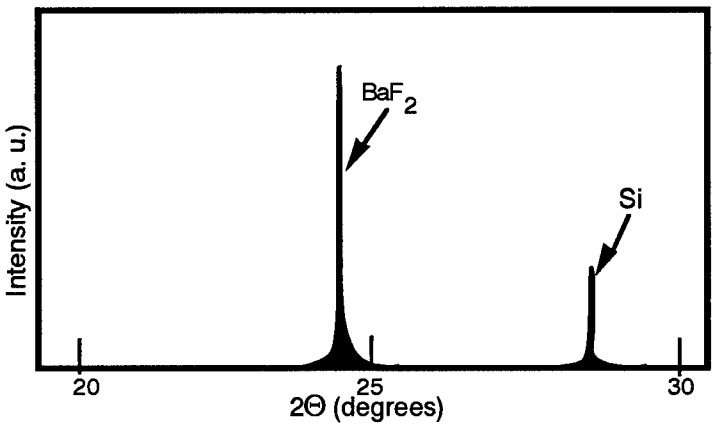

Fig. 1 A typical XRD spectrum of BaF_2/Si

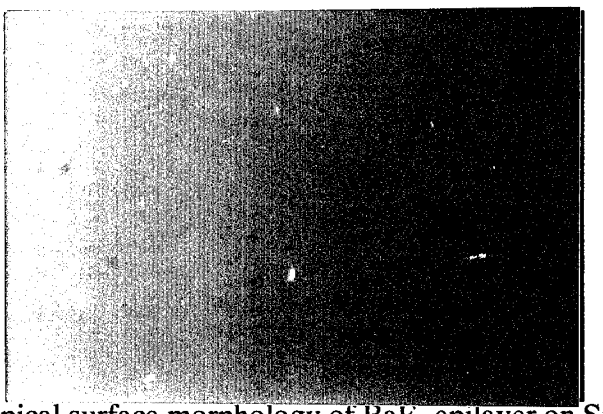

Fig. 2 A typical surface morphology of BaF_2 epilayer on Si substrate

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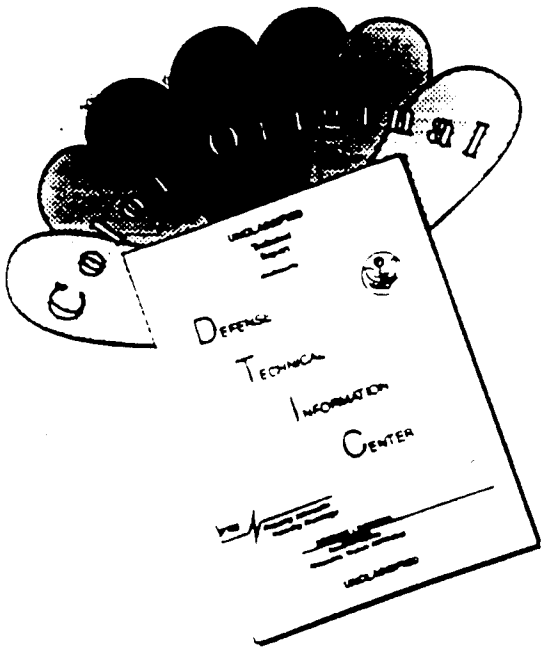

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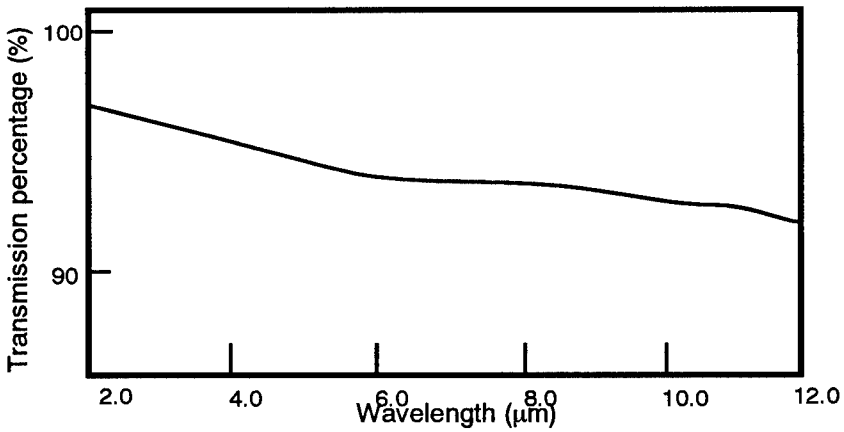

Fig. 3 A normalized IR spectrum of BaF_2 epilayer grown on Si

3.0 Preliminary InAsSb growth

We have performed over ten growth runs of InAsSb epilayer to optimize its growth condition. The carrier mobility of InAsSb films grown at different substrate temperatures was determined by the Van der Pauw technique. Fig. 4 shows that the carrier mobility of InAsSb film grown at substrate temperature of 350°C has the highest value (1.2 x 10^4 cm^2/V-sec).

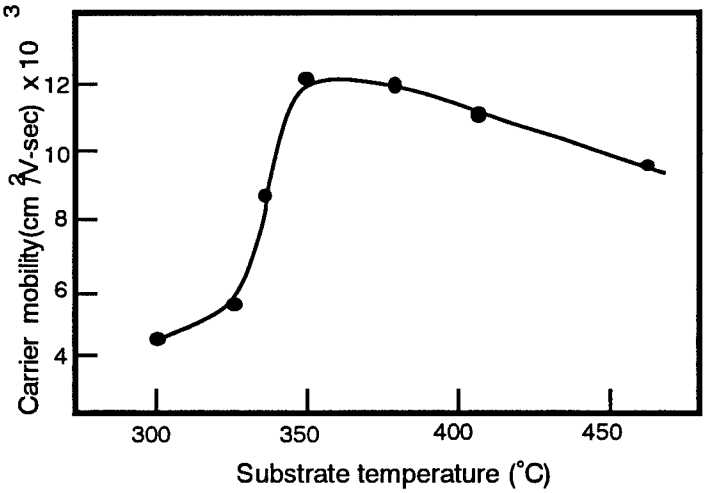

Fig. 4 Carrier mobility vs. substrate temperature of InAsSb epilayers

4.0 Conclusions

In this period, the optimization process of fluoride buffer layer on Si has been completed. The smooth surface and IR transparency in the 2 - 12μm ranges shows that single crystal BaF_2 epilayer is an effective buffer. The optimized growth condition for InAsSb is 350°C. The highest mobility of InAsSb film is about 1.2 x 10^4 cm^2/V-sec, which is suitable for device fabrication. The tasks for the next period will measure film thickness uniformity and mobility uniformity over the substrate.